Now, according to Legendre, the perimeter in this case is $2\pi(\cdot 90277992)$, so that the rule gives the desired result correct to within one hundred-millionth of 2π. THOMAS MUIR.

Cape Town, South Africa, May 19.

The "Armorl" Electro-Capillary Relay.

IN reply to your correspondent "J.-S." (p. 151), I may say that the model which I saw did actually work; it illustrated the flow of mercury from a fine jet when subjected to the influence of a small electromotive force, in the same way as described with reference to Fig. 1 of my article. I think your correspondent slightly misunderstands the principle of the instrument; it is not the small movement of the mercury, such as is used in the ordinary capillary electrometer, which works the relay lever; this movement merely serves to force some of the mercury out of the jet, and the *falling mercury* then moves the lever.

The inventors claimed that they had succeeded in effecting so nice a balance of forces that the mercury flowed from the jet under a very small influence. I join with your correspondent in the desire (which I expressed also in my article) that some trustworthy data concerning the instrument should be published.

June 13. THE WRITER OF THE ARTICLE.

SCIENCE AND MILITARY EDUCATION.

THE report of the Military Education Committee was issued to the public on Saturday, June 7, and has been the subject of much comment in the Press. The conclusions and recommendations of the Committee have been well received on the whole, though there are some exceptions, as in the case of the *Spectator*, which would wish to see Sandhurst done away with, or rather used in an entirely different manner and at a later stage in the officer's career, and in that of the military correspondent of the *Times*, who, in the course of a long article, falls foul of an important passage relating to science, and in effect advises the War Office not to accept or act upon the recommendations of the Committee on this subject. The writer of the article goes so far, indeed, as to suggest that the Committee has not sufficiently considered the evidence, quoting Sir George Clarke in support of the merits of Latin in such a way that we were not a little surprised on turning to Sir George's evidence to find that, when questioned as to the proper preliminary training of cadets (Question 839), he expressed the opinion that they should have a "broad, liberal education," adding that "the broader it is and the wider its scope, and the sounder generally, the better it will fit them for the special training they receive afterwards."

The passage objected to by the *Times* correspondent (20) will be found on p. 5, and, appearing as it does over the signatures of two such eminent representatives of classical training as the head masters of Eton and St. Paul's, is so important that we print it in full. It is as follows:—

"The fifth subject which may be considered as an essential part of a sound general education is experimental science, that is to say, the science of physics and chemistry treated experimentally. As a means of mental training, and also viewed as useful knowledge, this may be considered a necessary part of the intellectual equipment of every educated man, and especially so of the officer, whose profession in all its branches is daily becoming more and more dependent on science."

Considering the uncompromising terms of this statement, it is disappointing to find that a committee holding such clear and strong views should have found itself, in the event, unable to agree upon a scheme which would ensure that this "necessary part of the intellectual equipment of every educated man" should be provided for each and all our future officers. For it cannot be denied that the actual position proposed for science in the scheme recommended, viz. that it should be alternative in Class I. with Latin, will put it in the power of opponents of science to prevent candidates who may come under their influence from having the opportunity of securing this "essential part of a sound general education."

In saying this we do not overlook the fact, as some are disposed to do, that the proposed arrangements will allow those who select Latin as their subject in Class I. to offer science as a Class II. subject, and that, consequently, neither of these two necessary subjects need be neglected. But after making all allowance for the manner in which the scheme as a whole will qualify the effect of the relations of Latin and science in Class I., we think the Committee has not sufficiently regarded the fact that as Latin is begun at a very early age, but chemistry and physics much later, candidates choosing their subjects at about fifteen, as many, and perhaps most, of them must do, will be much more likely to select the former than the latter from Class I. (see Questions 8630, 8631, 8632), leaving science for Group II., where, however, it becomes an alternative with several other subjects, and so is very likely to be squeezed out.

It is a striking illustration of the effects of the neglect of science in our educational system, which even now is being remedied but slowly in some of our schools, that so many soldiers and others still make the mistake of supposing that as regards science the Army only needs "a proportion of scientific experts among military officers for suggesting and following up improvements in *matériel*," and that "the majority of such experts can be better obtained from civilian sources outside the Army than from within its ranks." The last part of this statement is, indeed, in spite of all the fine qualities of our officers, only too sadly true. But it is just because the basis of military education (and indeed of nearly all English education in the case of the abler members of the higher classes) has been too narrow in the past that the Army has failed to throw up a sufficient supply, we will not say of trained scientific specialists, but of officers capable of understanding the specialists, of absorbing their ideas, mastering their methods and applying these in the operations of war. How can we expect average men whose training has been mainly in language and mathematics to be resourceful and confident when brought face to face with the problems created for their profession by the revolutions of the last half century? Every question, said Liebig, one of the creators of much that is strongest in modern Germany, put to science clearly and definitely has been satisfactorily answered before long. Only when the inquirer has no precise idea of the problem to be solved does he remain unsatisfied for long. It is just because the majority of our officers have not had the broadest training possible, that so many are unable to make use of the new powers that science holds out to them, and are still under the mistaken impression that the main use of science in education lies in the facts which it provides.

It is clear that even now many educators and soldiers have not grasped the real elements of this great problem, and that they still fail to see that the object with which science is now taught is, not to convey a few more facts or a few facts of a new kind, but to preserve those habits of mind and that fertility of resource which daily become more important in face of the problems of modern life, and which are not to be gained by a purely literary and mathematical training. All will agree that faculties which must especially be cultivated in our officers "are power of command, habits of leadership, and the ability to act decisively and correctly at the right time and place." But when it is contended, as it often is, that "study in a chemical laboratory does not make for this kind of fitness," it is forgotten that laboratory work properly done will certainly develop these qualities at least as well, and probably better, than any study in

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which books only are concerned, and that we do not teach either science or Latin, mathematics or modern languages primarily to produce the habit of command, but because the habit of command and the ability to act with decision have a tenfold value in the man who is many-sided in his knowledge and experience and who, in the language of the street, "knows where he is" in many departments of human activity.

The object of a training in experimental science is not to stuff the mind with knowledge, as so many still seem to think, but to open and prepare it to receive and rightly apply knowledge in the after working years of life. Those persons are indeed ignorant who suppose that in a modern course of work, let us say, in physics, a boy's mind is "stuffed with knowledge" or that a course of work in electricity gives less play to the imagination than getting up vocabularies or irregular verbs. But we must not follow a bad example; these things also make for goodness in their degree.

As we have said above, the report of the Committee has, as regards its main features, been received with a chorus of approval, and little remains to be said about it. We think the proposal of an expert educational committee with advisory powers excellent. We are glad that whilst science and Latin are alternative subjects in Class I., the subject not taken as a Class I. subject can be taken as a Class II. subject. At the same time, we regret that Sir Michael Foster did not succeed in prevailing on his colleagues to embody in their final recommendations the admirable opinion which we quote at the beginning of this article.

If we may judge from the tenor of the discussion at the Conference of Science Masters last Christmas, we think the proposed changes in regard to practical work in chemistry will be widely welcomed. But if this reform is to work well, no attempt must be made to *add* the new scheme of practical work to the old requirements in qualitative analysis. The time which did not suffice for the latter alone cannot be sufficient for both together. We believe, too, that many teachers both of chemistry and physics would be most willing to see the scope of the syllabus in their special subject reduced a little, in order to secure that all candidates taking science should include in their work the "pass part" portions of both the chemical and physical divisions of science.

A HOLIDAY CRUISE TO ALASKA.[1]

THESE two handsome and magnificently illustrated volumes should be brought to the notice of every man of wealth as a lesson in the art of spending a holiday. He will learn therefrom how this may be done with permanent satisfaction to himself and permanent advantage to science.

In a pointedly brief and unassuming preface the patron of the expedition explains that, having planned a summer cruise through Alaskan waters for himself and his family, he found that the steamer which he had chartered would accommodate a larger party, and therefore resolved to seek "some guests who, while adding to the interest and pleasure of the expedition, would gather useful information and distribute it for the benefit of others."

By the advice of his physician he obtained the aid of Dr. C. Hart Merriam, chief of the Biological Survey of the U.S. Department of Agriculture, in carrying out this plan.

The outcome is succinctly stated in the introduction (pp. xxv–xxxi) by Dr. Merriam, who has most capably fulfilled his duties as general editor to the records of the cruise:—

> "In the early spring of 1899 Mr. Edward H. Harriman of New York, in cooperation with the Washington Academy of Sciences but entirely at his own expense, organised an expedition to Alaska. He invited as his guests three artists and twenty-five men of science, representing various branches of research and including well known professors in universities on both sides of the continent, and leaders in several branches of Government scientific work. . . . The expedition sailed from Seattle May 30 . . . and was gone just two months."

The ship threaded the "inside passages" from Puget Sound to Juneau, Skagway and Sitka; thence along the open coast to Cook Inlet and the Alaska Peninsula, and past the Aleutian Islands into Bering Sea, up to the entrance to Bering Strait, touching at Eskimo settlements on both the Asiatic and American coasts, and then turning homeward. The voyage was not in itself in any way remarkable; the interest centres in the personnel and methods of the expedition.

As for the personnel—the following list will show that the selected scientific party was qualified to take advantage of every opportunity. Botany was represented by F. V. Coville and T. H. Kearney, jun., of the U.S. Department of Agriculture, and by Prof. B. E. Fernow, of Cornell, Dr. A. Saunders and Dr. W. Trelease; zoology in its various branches by Dr. W. R. Coe, of Yale, D. G. Elliot, of the Field Columbian Museum, Dr. A. K. Fisher and Dr. C. H. Merriam, of the U.S. Department of Agriculture, R. Ridgway, of the Washington National Museum, C. A. Keeler, of the San Francisco Museum, Prof. W. E. Ritter, of the University of California, Prof. T. Kincaid, of the University of Washington State, and Dr. G. B. Grinnell; geology and geography by Dr. W. H. Dall, G. K. Gilbert and H. Gannett, of the U.S. Geological Survey, and Prof. B. K. Emerson, of Amherst; mineralogy by Dr. C. Palache, of Harvard, and W. B. Devereux; meteorology by Prof. W. H. Brewer, of Yale; and nature-lore in its literary aspect by John Burroughs and John Muir. Of the three artists on the ship Mr. L. A. Fuertes was a specialist in bird-portraiture—sixteen of the many beautiful coloured plates which adorn these volumes attesting his skill. We learn, moreover, that a fourth artist was sent to Alaska in the following year for the special purpose of securing drawings and paintings of Alaskan plants! The expedition also included two photographers, two taxidermists, two stenographers; with a chaplain, two physicians and a trained nurse. The Harriman family party numbered eleven.

As for the methods—these seem to have been in every way admirable. Under unskilful management the scheme would probably have come to nought through the stress of divergent interests. But the patron of the expedition met the occasion like a whole-hearted democrat. His procedure is thus described by Dr. Merriam:—

> "The day after leaving New York Mr. Harriman called together the members of the Expedition and announced that it was not his desire to dictate the route to be followed, or to control the details of the work. In accordance with his wishes a business organization was effected, comprising an executive committee, a committee on route and plans, and special committees on the various scientific activities. These committees, throughout the voyage, held frequent meetings and determined from day to day the operations of the expedition. . . .
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> "Among the unusual features which contributed to the success of the Expedition, three are worthy of special mention:—
>
> "(1) The ship had no business other than to convey the party whithersoever it desired to go. Her route was entrusted to a committee comprising the heads of the various departments of research; so that from day to day and hour to hour her movements were made to subserve the interests of the scientific work.
>
> "(2) The scientific staff represented varied interests and was made up of men trained in special lines of research.

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[1] "Alaska. Harriman Alaska Expedition, 1899." 2 vols. Royal 8vo. Pp. xxxvii + 383, with 39 coloured plates, 85 photogravure plates, 240 text figures and 5 maps. Vol. i. Narrative, Glaciers, Natives. Vol. ii. History, Geography, Resources. By many authors. (New York: Doubleday, Page and Co., 1901.)

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